Simulate to stimulate medical trainees

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Flight simulators first appeared in the early 1940s and today they are an essential training tool for pilots, who receive hours of simulated flight before trying the real thing.

Today the 1990s version of this technology is also revolutionizing medical training, and word is spreading rapidly on the Internet thanks to dozens of sites dedicated to the topic. Virtual reality (VR) systems for all types of medical disciplines are being developed, and while these early models are crude they are evolving rapidly.

VR is the art and science of deception. Through stimulation of the senses, VR systems attempt to fool the brain into believing the unbelievable. This requires immersion into an electronic environment that is as interactive and complex as the real world, but until now this has been impossible.

However, in recent months there has been an explosion in the number of medical VR trials, with MEDLINE alone now offering 232 citations on virtual reality — and counting. Researchers are scrambling to report findings from various kinds of VR systems, and while most of the systems focus on training benefits for residents and students, some are already in use as planning tools for real-world clinical applications.

John Waterworth, senior researcher in the Department of Informatics at Sweden's Umeå University, says the reason for the interest in VR is clear: "There is something of a crisis in current surgical training. As the techniques become more complicated and more surgeons require longer training, fewer opportunities for such training exist."

In his report *Virtual reality in medicine: a survey of the state-of-the-art* (**www.informatik.umu.se/~jwworth/medpage.html**), Waterworth says technology is ripe for serious advances in medical VR applications.

For example, the UCLA School of Medicine now uses a VR system of the human skull to train medical students. The 3-D digitized image of the skull is presented to students in a computer lab, and they interact with it using special goggles. A "mouse-pointer" lets them explore all aspects of the specimen without contacting the "real thing."

Another recent application is an arthroscopy training simulator. Currently this diagnostic method is learned through hands-on clinical experience, but German researchers have developed a VR system to help in the training. Using actual data from MRIs, the team has designed a system that lets the surgeon interact in a virtual 3-D setting.

And in a similar endeavour, a French team developed a training simulator for retinal photocoagulation. Using 2 groups of residents, one trained using this new VR tool and the other using conventional methods, they found VR to be "at least as efficient . . . and it may even reduce training duration."

Despite these early advances, "force feedback" remains a major hurdle in medical training via VR because the sense of touch, one of the most primitive and basic of the 5 senses, turns out to be the hardest to fool.

However, research reported last month during the 67th annual meeting of the American Society for Plastic and Reconstructive Surgeons shows significant progress in this area. Drs. Paul Gorman and William Graham of Pennsylvania State University reported on a new VR system that uses both visual and tactile simulation to teach microsurgical vascular anastomosis.

"Virtual reality has been available previously, but this study shows that with miniaturization it can also be used to teach microsurgical skills such as suturing tiny nerves, arteries and veins," Graham said during the meeting. "This very sophisticated device provides an extraordinary learning experience."

It uses a computer to provide 3-D graphics, microsurgical instruments attached to haptic (sense-of-touch) devices to provide tactile feedback to the surgeon's hands, and a personal computer to control the haptic devices. This system senses instrument location and provides proper physical resistance. This means that trainees not only see the effects of their work in VR space, but they also feel it.

Graham says VR training will one day replace the need for "real" microsurgical training at the basic level. That day may not be here yet, but the rapid advances in computing power and software design mean it is closer than ever.

The clearest sign of these advances is found on the 'Net, with the following sites being particularly useful:

- Sources and resources in medical VR: products, people, organizations and information — **www.informatik.umu.se/~jwworth/4Resources**
- *Frontiers in Bioscience* (online journal) — **bioscience.igh.cnrs.fr/medinfo/resource/vr.htm**
- The European site for virtual reality in medicine — **www.psicologia.net/pages/main.htm**
- Virtual reality in medicine — **www.eng.iastate.edu/~stefanch/575_presentation.html**
- Virtual environments and surgery simulation — **www.cc.gatech.edu/gvu/visualization/surgsim/**
- Virtual Reality Society — **www.vrs.org.uk/**

The message in all of them is clear: simulate to stimulate. ?